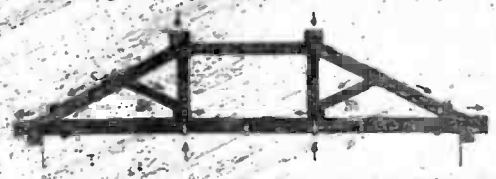
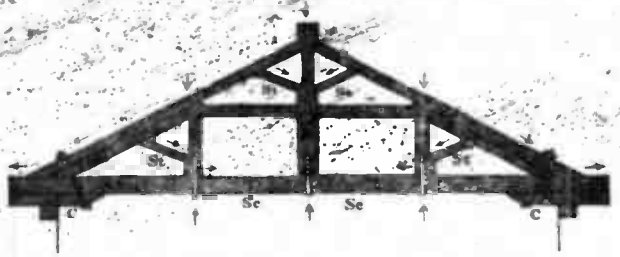
strining-beam; and sometimes a smaller collar-beam, termed a straining-sill, is placed upon the tie-beam, between the feet of the queen-stirrups.



P. P. Principals.
T. Tie-beam.
Q. Q. Queen-stirrups hung to the heads of the principals, and suspending the tie-beam in two places.
St. St. Struts abutting upon the feet of the queen-stirrups, and supporting the principals.
C. Collar-beam, hammer-beam, or straining-beam.

Increasing the number of suspenders to the tie-beams, renders smaller and weaker timbers sufficiently stiff for the purpose of tie; and the principals being also shortened partake of the same economy.

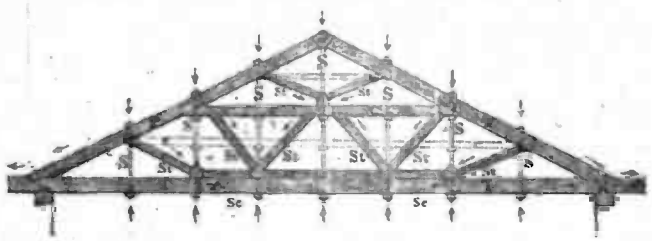


P.P.P.P. Principals.
T.T. Tie-beam.
K. King-stirrup hung to the heads of the upper principals, and sustaining the tie-beam in its centre.
Q.Q. Queen-stirrups hung to the heads of the lower principals, and sustaining the tie-beam between its centre and its ends. The upper principals may also be made to support more of the burthen by passing round them iron straps from the heads of the queen-stirrups.
St.St.St.St. Struts abutting upon the king-stirrup and queen-stirrups, and supporting the upper and lower principals.
C.C. Collar-beams between the king-stirrup and queen-stirrups.
c.c. Corbelles of oak to strengthen the ends of the tie-beam where all the weight and action of the truss are concentrated.
Sc.——Sc. The part of the tie-beam in which the timber may be scarfed, the counter-direction of the lower struts there pressing the parts of the tie-beam together, while at the other parts of the tie-beam the principals and the struts acting in opposite directions, strain asunder the parts of the tie-beam.

Sometimes three suspenders are obtained to the tie-beam, by forming a queen-truss, as here shewn; and this kind of framing will answer properly for a roof 60 feet or 80 feet span. Sometimes instead of one king-post, this description of truss has two boards hung to the heads of the upper principals, and extending down to the tie-beam; in this case the collar-beam is in one piece, and passes between the two boards. There is yet another method of managing this king-post as practised more than 400 years ago, at the Basilica of St. Paul at Rome. This was by splitting as it were the whole truss longitudinally into two separate lighter or half trusses, and then keying the king-post between these two separate trusses, so as to form one mass. Suspenders of iron obviate this reduplication of the trusses. If it be determined to split each truss into two, it will be best then to place them only half as far apart as they would otherwise have been, and thus reduce the bearing, bulk, and burthen of the purlins, and hold in the walls at twice the ordinary number of places, and perform all this with a smaller quantity of material.

The points of suspension may in this last description of truss be still further increased to seven in number, by screwing through the tie-beam four intermediate queen-bolts of wrought-iron hung to the backs of the principals.

The last-mentioned kind of truss may be simplified, by using only two principals instead of four of them, and by making all the suspenders of wrought-iron. Indeed, there is no limit to the number of suspenders which may be used in this system of framing; the more these are in number, the lighter may be all the parts of the truss except the two inclined beams or principals, which can only be lightened in proportion to the burthen which they have to carry. The span of this kind of truss is only limited by the length of timber which can be obtained for the principals: 95 feet is the greatest length of fir timber which the author remembers to have seen in England, so that 150 feet or 160 feet is perhaps the utmost span to which this truss can be carried without scarfing the principals, which is unadvisable, as the more there are of such joints the greater will be the settlement of the framing.

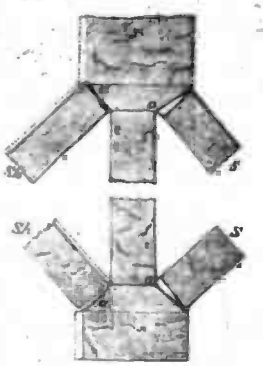


P. P. Principals.
T. T. Tie-beam.
S. S. S. S. S. S. S. Suspenders of wrought-iron hung to the backs of the principals, and holding up the tie-beam.
St. St. St. St. St. St. St. St. Struts abutting upon the suspenders, and directed exactly to those points of the principals which receive the cross-strain of the suspenders and the burthen which they have to carry.
C. C. Collar-beam.
cc. cc. Other collar-beams which may be framed in short pieces between the struts, but which will become loose by the shrinkage of the struts, and will then require re-adjustment.
Se. Straining-sill.
Sc.——Sc. Parts of the tie-beam between which the timber may be scarfed.

All timber trusses are subject to very considerable downward settlement from their weight, from the natural flexibility of the timber, and from the shrinkage of it by drying: in order to counteract the effect of this settlement, it is usual to form at first the tie-beams of trusses with an upward curvature called a camber, so that after the unavoidable settlement has occurred, the tie-beams, with the ceiling or whatever else may be attached to them, may not droop down. But it must be observed, that the deflexure of the tie-beams of trusses is increased by the reprehensible practice of framing the king-posts and queen-posts at first close into the tie-beams, by which practice, the slightest depression of the principals by settlement, causes the king-posts and queen-posts to punch in immediately the tie-beams, and thus to cause them to sink; whereas, if the king-posts and queen-posts be only attached loosely to the tie-beams by stirrups of irons, as is the case in the roof of the Theatre d'Argentina, at Rome, and as was also the case in some of the trusses of the Basilica of St. Paul, at Rome, all deflexure of the tie-beams may at any time be corrected by wedges or by screws, and thus a ceiling the most sunken may be restored to its original level.

The ordinary mode of forcing up a tie-beam to an excessive camber, is very ignorant and reprehensible; for the tie-beam then, not only by its own weight but also by its natural spring, endeavours to recover its natural state of rest; and thus the principals become the more readily deflected and deranged: to draw up the tie-beam by screws or wedges, only after it is deflected, is to leave the principals free from all strain except that caused by gravity.

In framing the principals and struts into king-posts and queen-posts of ordinary unseasoned timber, it will be well to leave the diagonal joints at first open, as shewn in the adjoining wood-cut, at the letters a, a, so that when the broad heads and feet of the king-posts and queen-posts have completely shrunk, and rendered the abutments more steep, the principals and struts may fit closely, as shewn at the letters a, a.



S. S. A principal and a strut framed with open abutment into a king-post or suspender of new timber.
a. a. Open crevices left at first in the framing.
SA. SA. A principal and a strut originally framed with open abutments, but afterwards fitting closely by the shrinkage of the timber altering the abutments a, a, to the requisite steepness.

It should be a general maxim with the architect, never to leave exposed to the weather, members of buildings so important as trusses, whether of timber or of iron; if of timber, they may rot, and the fabric may thus become endangered; and if of iron, decomposition will take place, and every thing around them be tainted with rust.

Dr. Robinson asked, with regard to the trusses of roofs, the following excellent remarks:—

"Nothing shews the skill of a carpenter more than the distinctness with which he can foresee the changes of shape which must take place in a short time in every roof. A knowledge of this will often correct a construction which the mere mathematician thinks unexceptionable, because he does not reckon on the actual compression which must obtain, and imagines that his triangles, which sustain no cross-strain, invariably retain their shape till the pieces break. The sagacity of the experienced carpenter is not, however, enough, without science for perfecting the art. But when he knows how much a particular piece will yield to compression in one case, science will tell him, and nothing but science can do it, what will be the compression of the same piece in another very different case. Thus he learns how far it will now yield, and then he proportions the parts so to each other, that when all have yielded according to their strains, the whole is of the shape he wished to produce, and every point is in a state of firmness. It is here that we observe the greatest number of improprieties. The iron straps are frequently in positions not suited to the actual strain on them, and they are in a state of violent twist, which both tends strongly to break the strap, and to cripple the pieces which they surround."—*System of Mechanical Philosophy*. Sir David Brewster's edition, Edinburgh, A.D. 1822, vol. i. p. 60, § 576.

There are two observations more to be made concerning mechanical trusses: the first with regard to *struts*, and the second with regard to the *feet* of principals.

With regard to struts, it seems to be rather extensively imagined that they are as much placed according to some vain ideas of symmetry, or of particular inclination, as for any useful purpose; whereas it should never be forgotten, that their only use is to prevent weak principals from being deflected by purlins, or

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